A VIRTUAL LABORATORY FOR DATA COMMUNICATIONS

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ABSTRACT

Since 1986 Data Communications has been taught to both internal and external students of the Central Queesland University(CQU), formerly Capricorn Institute of Advanced Education(CIAE). Throughout this period, staff have struggled to meet the challenge of creating an engaging educational experience that can be delivered to all students. In an effort to transport the classroom to the external student we have developed a set of multimedia resource materials, appropriate for flexible delivery, to be distributed to students studying Data Communications in their second year of a Bachelor of Information Technology or Bachelor of Information Systems.

In recent years internal students have been exposed to physical materials in the lecture and tutorial environment. Their reaction has been very positive and outcomes include enhanced understanding and reasoning. In contrast, external students have little or no opportunity for this type of exposure through their distance study program.

The objective of the project we have undertaken is to provide all students, especially external students, with a virtual laboratory environment where they can be exposed to the physical and technical aspects of electronic communications equipment. Many of the other virtual laboratories or classrooms that have been developed by other Australian or overseas Universities have been developed to be delivered via the Internet and sometimes include interactivity [4], or simulations/animations [2]. The majority of topic areas that have been transformed into virtual laboratories have come from the areas of Science, Engineering or Mathematics. In these areas the ability to test theories or perform experiments is crucial to knowledge formation and assessment.

The project is constructed of a menu based Multimedia presentation to be distributed on CD-ROM that leads students through photographs, audio and video that would normally be seen in lectures, laboratories and tours enabling us to effectively disseminate this otherwise inaccessible experience to all students. Our attempt is to replace impersonal textbook illustrations with real-life static and dynamic footage of a data communications networking environment.

KEYWORDS

Virtual Laboratory, Virtual Classroom, Data Communications, Networking, Multimedia.

BACKGROUND

Currently the live interactive and visual experience has only been available to CQU's internal students at Rockhampton, and to a limited degree those students on the three regional campuses throughout Queensland who join the lecture via videoconference. The multimedia CD-ROM presentation aims to give distance students the opportunity to examine virtual pieces of hardware accompanied by audio and visual explanations that detail the physical attributes and technical aspects of a variety of devices.

Many of the concepts and techniques taught in Data Communications and Networks are of a practical nature, but in the past there has been no way of conveying the same message as the face-to-face, hands-on experience. After careful study of the syllabus we have been able to identify and incorporate critical knowledge items into a multimedia CD-ROM. This we believe will help to bridge the gap between the written word students are presented in their textbooks and the actual environment they will experience in the working world. Currently, 34% of the students taking the Data Communications and Networks course are External and 66% are Internal. Only 18% of the Internal students presently have access to all the interactive activities. With such a large percentage of students not being able to access important interactive activities it is essential that these activities be provided via another medium.

HOW

Through a university-wide team approach we have been able to incorporate in the multimedia package a virtual tour of the University corporate infrastructure networking facilities and a digital photo gallery of pieces of communications hardware.

The CD-ROM experience consists of a menu based multimedia presentation created using Macromedia Director 8. The presentation enables each student to view digital photographs, audio and video representing the sights and sounds that would normally be experienced in lectures, laboratories and tours. Packaging these features on a self-contained CD-ROM allows for easy distribution to all distance students around the world without the need for them to access Internet technology that can be expensive and unreliable.

At the beginning of the multimedia presentation students are given two main menu options:

- Enter the Digital Photo Gallery, or
- Take a Virtual Tour of ITD (Information Technology Division).

THE DIGITAL PHOTO GALLERY

If the student chooses to view the digital photo gallery they are asked to select one of the available categories:

- Home,
- Connecting,
- WAN (Wide Area Networks),
- Wireless or
- General.

The decision on how these devices should be categorised was not an easy one. Our major concern was to classify the devices in a way that would be easy for the student to guess where a particular device could be found. We found there were a large number of devices that overlapped our many variations on the categories and considering what was the best solution was made difficult by this duplication effect. The final decision was to list all the overlapping devices under a “General” category eliminating as much duplication as we could. Whilst providing a “See Also” list in the hardware display screen that references many of the devices that are similar in nature or work in partnership with the hardware being viewed.

Under each category is a list of hardware that might typically be found in these situations, for example under "Home" one would see:

- Modem External,
- Modem Internal,
- Modem PCMCIA, and
- Cables and Ends.

After choosing a piece of hardware, a digital photograph and a short written explanation of the technical and physical aspects of the device are displayed. From any point in the presentation navigation buttons allow the student to step back one screen or return to the main menu.

The digital photographs were taken from various sources. Many of the photographs in the "Home" category are pictures of someone's home set-up. The other photographs came from the University infrastructure and businesses in the local area.

THE VIRTUAL TOUR OF ITD

If the student chooses to take the virtual tour of ITD they are introduced to a selection of videos with a short "sting", which is made up of a sequence of images taken from the tour and accompanied by music. From here the student has the option of viewing one of the short videos (none of which are more than three and a half minutes in duration) from one of the following areas:

- ATM/Ethernet;
- Cabling;
- Management;
- Microwave;
- Modems or
- Switches.

After the student clicks on the textual link or the digital photograph icon an additional "Director stage" is created and a QuickTime movie is played. On completion of the QuickTime movie the Director stage is removed and the student is returned to the video selection and is able to view another video or return to the main menu.

PRODUCING THE SHORT VIDEOS

Our first consideration in creating the short videos was the audience. Who is our audience and what is their presumed knowledge? We started with a general script as we were unsure what would be presented in the tour. We knew only broadly what equipment would be shown to the students and the detail in which it would be discussed. We would then need to decide which parts of the tour would make for interesting viewing in a short video.

Our next consideration was the medium on which we wanted to distribute this information to the students. Firstly we had to decide on a presentation style. Did we want a single continuous video, to be watched like a documentary, or did we want short sharp videos to grab the students' interest and focus on only one specific topic? The length of the video was a major consideration when choosing the filming method and the final distribution medium.

Our choices ranged from sending a commercial style VHS cassette to the students with a documentary style program, or using a CD-ROM or the Web for distribution, confining us to short films, forcing us to split the tour into a number of individual topics.

These considerations would influence our filming and editing methods. Our decision to create short videos was due to two reasons:

- The video tour was one of a number of resources that needed to be sent to external students, so the chosen medium was CD-ROM.
- The video was going to form part of a multimedia package created using Macromedia Director 8, so short videos would fit better in a menu style package.

All of the video footage was captured using a Sony Hi8 digital video camera and edited on an Avid non-linear editing machine. The Sony Hi8 had some real advantages over larger and older video cameras. The Sony Hi8 is a very small, lightweight and mobile camera; it is about the size of a personal video camera and can be easily carried or mounted on a small tripod. This made manoeuvring in the small and sometimes-awkward areas of computing equipment rooms much easier than with a larger camera that requires a separate battery pack. The Song Hi8 also records in digital format at broadcast quality and is highly compatible with the Avid non-linear editing machine.

Using an Avid non-linear editing machine meant that the original video footage would need to be copied only once from tape to QuickTime format files. Once in this format the files can be used over and over again to cut and paste snippets of footage creating a set of short videos. The advantage of this method is that computer files do not lose their quality, even after numerous playing, cutting and pasting. Continually rerunning original footage from videotape will result in degradation of the quality of image.

The Avid non-linear editing machine constructs videos using a layered design. One of the layers will be the visual footage another could be effects and another could be audio. After layering these all together you can play the segment and see the finished product with the layers playing simultaneously. The new segment can then be saved as a QuickTime movie.

The QuickTime movie segment is then put through a program called Media Cleaner, this allows you to crop the segment so that any fringe images can be cut out of the finished product giving you a cleaner final image. Media Cleaner also gives you ability to set the:

- Frame rate per second;
- The type of final medium required, for example CD-ROM/Web or DVD etc;
- The format of the final product, i.e. QuickTime or AVI-MPEG etc and
- Add any effects settings you would like at the start or end of the segment, like fade to black at the start or end or both, or cut to black, etc.

After the filming of the tour the general script was revisited. The script grew largely out of the audio we had recorded during the tour. Although we were unable to use any of the audio from the tour itself it did provide us with much of the detail we needed to fill out the script. The audio recording on the videotape was unusable due mainly to the fact that we were not able to get close enough to the presenter to record him clearly and there was considerable background noise from the equipment.

The combination of the initial script and the detail from the presenter worked out well. The initial script lacked the detail needed to convey the correct message and the presenter's words were sometimes too specific to relate meaning to a wider audience.

Once a script was finalised and a trial video segment was created a voice-over was recorded and was layered on top of the video segment. Our recording of the voice-over separate from the footage was a deliberate step. This technique was chosen, compared to direct matching of footage and words, as we felt that the voice-over explained the general topic area and the footage was designed to complement the voice-over by showing images of similar, but not the same, types of equipment. Using this method made it easier to lay the audio on top of the footage and achieve a good result in a short period of time.

Our decisions on footage and voice-over were designed to give all students, especially distance students, the opportunity to see actual pieces of equipment in their natural setting and feel more like a part of the class and the CQU campus.

The number special effects included were kept to a minimum. It was clear that the main emphasis of the videos was the visual footage of the tour and the audio of the voice-over so it was not necessary to include many other effects. We settled on including a small "sting" at the beginning of each of the short videos. The "sting" consisted of images, a title and some music.

After the "sting" we included a border around the footage for approximately the first 10 seconds to lead the student into the video (Figure 1). This was slowly covered as the video image enlarged to fill the whole screen. To indicate closure we shrunk the video footage to reveal the border again for 5 seconds before ending the video and fading to black.

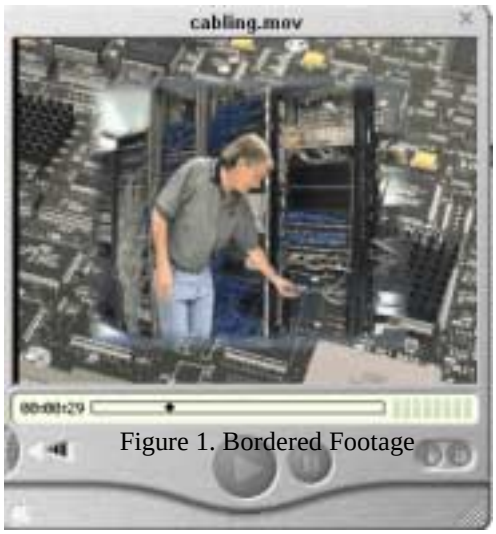

Figure 1. Bordered Footage

Figure 2. Introduction Sting

The "sting" at the beginning of each of the videos was quite easy to create with the most difficult part being the title. This was only difficult because it required 123 separate titles to be created and sequenced together to create the effect of the three letters "I" "T" "D", each of a different colour moving across the screen (Figure 2).

The voice-over was recorded on Mini Disk in an audio digital format that is compatible with the Avid non-linear editing machine. The audio was copied from Mini disk to the Avid non-linear and saved as an audio file that could be run the same way as the QuickTime movie footage gathered from the digital camera. This made listening and slicing the audio clip a simple process that enabled us to insert or remove pauses were necessary.

USING DIRECTOR

The initial choices we had for presenting the networks material was either:

- A combination of HTML and Macromedia Flash. This produces an entry-level quality but is a widely acceptable format; or
- Macromedia Director 8. This produces a more professional result and is still fairly widely accepted by our target users.

The main advantage of using HTML and Macromedia Flash is that it is a compatible format for both Apple Macintosh and IBM based computers running any operating system. The file types are standard, (jpg, mpeg, HTML) and burning the CD in an ISO9660 format makes it readable in most CD-ROM drives.

The second option of Macromedia Director 8 or a similar presentation tool gave us more flexibility and allowed us to create a much more professional presentation. Director files can also be compiled into a self-executing program for both Windows and Apple Macintosh.

Director is fairly easy to use with a programming interface like that of Flash, with the advantage of the Lingo programming language behind the up-front presentation allowing for more complex instructions to be carried out. Director also supports QuickTime movie format.

The first consideration when using Director was to establish a size for the presentation; this is referred to as a "stage". The stage could be set as either a windowed or full screen application. Using a windowed stage allows the user to easily access other icons on their screen without having to close down the application. This was seen as beneficial as students could have the Webpage for the course open and be studying the materials or viewing the schedule at the same time as choosing a video to watch or a category of photographs to view. The stage size could be set to 640x480 pixels, 800x600 pixels or something in between.

The QuickTime movie could be displayed inside an additional stage and would be around 320x240pixels in size. This would achieve a good window for clear viewing, while also keeping to manageably small video files. The additional stage would fit easily in a 640x480 pixel stage without resizing as long as the other elements of the page were organized efficiently. An 800x600 pixel stage would allow more room for layout, however the video would remain 320x240 pixels and students with older equipment who were restricted to viewing only in the smaller 640x480 resolution would lose a large percentage of the presentation area and viewing controls.

The tour videos are displayed on a stage that rises up from the bottom of the screen. The stage rises and sinks off the screen enabling us to overcome a deficiency in Director that doesn't allow for a video media element to be faded or wiped in.

The digital photographs were taken on a simple-to-use digital camera with a super high quality setting that enabled us to capture the detail we needed on the devices. The super high quality setting provided shots in about 1024x1280 resolution, this allowed us to finely clip the images and resize them down to fit into the 640x480 stage without losing picture quality. The wording displayed along side the digital photographs was constructed as a series of pages in a window. Buttons forward and back allow the student to flick through the material.

CONCLUSION

The main objective of this project was to provide all students, especially distance learners, with a virtual laboratory environment where they could be exposed to the physical and technical aspects of electronic communication equipment.

The idea for the creation of short videos and a photo gallery was driven by the need to simulate the personal experience that only a minority of students are able to access. The majority of students studying at CQU will not have the opportunity to see in real life the equipment and experience the ideas being presented in their courses.

Even though one of the main drawbacks of distance learning is the lack of interaction experienced [3]. We contend that another major drawback for technology-based subjects is the exposure to the equipment and its place in the data communications environment.

The main emphasis in the creation of this multimedia package was to create a virtual computing laboratory environment that gives the distance student the opportunity to see and hear about the areas they are learning about and to feel like they are more a part of the course and University where they are studying.

This CD-ROM is not meant to be an interactive virtual laboratory, nor a home study kit, nor a simulation of reality with predefined questions and answers, nor the static material presented in printed resource materials, textbooks or videotapes of lectures [1]. We hope that this project will contribute towards the enhancement of the distance education experience and go some way towards providing educational equity.

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